PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in and connected with Apparatus for the Treatment of Materials with Fluids such as Air or Gases for the Drying, Cooling or like Conditioning of such Material.

We, ALFRED DANGERFIELD, of No. 74, Castlenau, Barnes, Surrey, British subject, MORTIMER LEE WARE, of 356, North End Road, Fulham, London, S.W., British subject, JAMES SEATON, of 238, Wandsworth Road, Clapham, London, S.W. 18, British subject, and ADOLF FRANZ HEUSCHKEL, of 35, Grove Road, Brixton, London, S.W. 9, Czecho-Slovakian subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention comprises improvements in and connected with apparatus for the treatment of materials with fluids such as air or gases for the drying, cooling or like conditioning of such material. For example, the apparatus may be used for the treatment of blood, meat, bones, fish, offal, leather, and various waste products or refuse of either organic or mineral origin. Also, the apparatus may be used for the treatment of grain products, such as wheat, corn, oats, maize and so on which have become unmarketable or have deteriorated owing to exposure to weather or absorption of moisture. Apparatus constructed in accordance with these improvements may be employed as a combined dryer and cooler in some cases while in others, the apparatus may be used for causing any given material to acquire a desired condition of coolness or heat together with a desired condition of moisture or dryness.

The invention is concerned with that kind of apparatus which comprises a series of worm or like conveyor troughs in which the material is conveyed to and fro, in zig-zag fashion, and always in contact with a counter-current of fluid such as air or gases having the desired temperature or qualities for imparting the pre-determined condition to the material under treatment, these conveyor means being practically air-tightly enclosed in a chamber or structure so that a suction fan operating at a convenient point draws only the air or gases as aforesaid in counter-current contact with the moving material.

It has heretofore been proposed, in connection with drying apparatus, to employ a furnace having two damper-controlled flues one leading directly to the chimney shaft and the other into the drying chamber so that the gases of combustion could be admitted either into the chimney shaft or into the treatment chamber at will, an air admission flue being also furnished so as to enable cold air to be admitted into the treatment chamber together with the gases of combustion.

According to this invention an apparatus of the kind referred to is so constructed that the material is delivered from the last or bottom trough of the series through an aperture in the outer wall of the treatment chamber or structure. With this arrangement heated material, in passing from the chamber through the aperture and into the surrounding air, is met by a current of cold air drawn in through such aperture owing to the suction of the fan and the advantage is gained that the heated material becomes sufficiently cooled by the time it is discharged, to enable it to be immediately bagged. Preferably, rows of troughs are used with two or more troughs in each row, in which case each trough of the last or bottom row delivers through an aperture in the outer wall of the treatment chamber. An improved furnace used in connection with the apparatus is distinguished by the fact that it is provided with a controlled cold air admission flue in addition to two damper-controlled

flues leading respectively to the chimney shaft or uptake and the treatment chamber, such cold air flue enabling any desired quantity of dry cold air to be admitted into the treatment chamber with the hot gases. In order to prevent the emission into the atmosphere of dust or small particles of the material undergoing treatment, the air or gases passing away from the conveyor troughs are led through a deposition chamber through which the draught is caused to pass in such a manner as to favour the deposition in such chamber of any solid material borne by the current flowing towards the suction of the fan. The worms of the conveyors are preferably composed of a number of helical blades of desired pitch, these blades being mounted on shafts provided with holes or other devices for facilitating the fixing of the blades thereto at different distances apart or in different angular relations.

In order to enable the invention to be readily understood, reference is made to the accompanying drawings, in which:—

Figure 1 is a perspective view of an apparatus or plant comprising the present improvements, this view being a sectional view as seen from the conveyor side and the wall and roof being broken away to disclose the operative parts.

Figure 2 is a perspective view as seen from the opposite side of the apparatus or plant, the wall and roof being broken away in this view to disclose the deposition chamber and the screens therein.

Figure 3 is a diagram of the gear wheels seen to the left hand of Figure 2, the diagram showing the direction of revolution of the respective worms which are driven by the said gear wheels.

Figure 4 is a cross section, to a smaller scale, of the upper portion of the deposition chamber and suction fan chamber.

Figure 5 is a transverse section of the furnace seen to the left hand in Figure 1, and

Figure 6 is a longitudinal section of the said furnace.

Referring to Figure 1, *a* is the treatment chamber containing the worm conveyor hereinafter described and *b* is the deposition chamber through which the air and gases pass after being drawn through the treatment chamber *a*. At the entry of the treatment chamber *a* there is a furnace or stove *c*, hereinafter described, and at the exit from the deposition chamber *b* there is erected a chimney shaft *d* for carrying away the exhaust or waste air or gases.

The conveyor comprises a number of superposed pairs of troughs *e* in each of which there is revolubly mounted a shaft *f* for carrying the helical blades *g* of suitable pitch forming the conveyor worm. As will be seen from the drawing, each shaft is formed with a number of holes or recesses suitably spaced from one another and the blades *g* are secured to the shaft by means of set screws or the like *h* which are screwed through the hubs or bosses of the blades *g* until their points enter the appropriate holes or recesses. The latter are formed at such distances apart and in such angular relation that it is an easy matter to dismount the blades *g* from the shaft and to re-mount fresh blades or re-secure the same blades at different distances apart or in different angular dispositions from those shown in the drawing. Therefore, it is an easy matter to provide for accelerating or retarding the passage of material to be treated which is an important consideration when taking into account the different natures or conditions of the various materials which may have to be treated from time to time. Also, blades suitable for giving a desired churning or agitation to one material may be substituted by blades in the same or in different disposition for giving increased churning or agitation to a different material.

The shafts *f* may be supported in bearings in end caps or box heads *j* fitted on to the ends of the troughs *e* thereby ensuring and maintaining the correct centering of the shafts in the troughs. If desired, the troughs may be secured by bolting down the box heads *j* on to cross girder irons mounted on or in the end walls and cross supports may be introduced at intermediate points for supporting the troughs *e* as will be readily understood.

The material to be treated may be raised by means of an elevator *k* to the top of a feed chute *l* down which the material falls on to the left hand end of the top pair of troughs *e*. Naturally, instead of arranging troughs in pairs, there may be three or more troughs in any horizontal row. The lower end of the chute *l* is fitted with means for equally dividing the falling material and distributing it on to the two troughs. This distributing means in Figure 1, is seen to take the form of an inverted V-shaped flap *m* suspended from a pivot shaft *n*, a hand lever *o* and connecting rod *p* being provided for circularly adjusting the shaft *n* and flap distributor *m*. When the latter hangs centrally, the material is equally distributed into the two top troughs *e* but the hand lever *o* may be operated for causing the flap *m* to be tilted to such a degree that the feed may be entirely cut off from one of the troughs

if this should be desirable for any reason. The worms are revolved so as to feed the material from the left hand end to the right hand end of the top pair of troughs *e*, the material then falling through apertures *q* in these troughs and being discharged into the right hand ends of the next pair of troughs beneath. In these latter troughs the material is fed by the worm conveyors from the right to the left until the material falls through the apertures *q* in the left hand end of these troughs and into the third pair of troughs from the top in which the feed takes place from left to right. This to and fro feeding is repeated for as many troughs as there are in the superposed series. Five superposed pairs are seen in Figure 1, but there may be seven or nine or any other convenient number, as will be readily understood. From the bottom pair of troughs *e* the material is delivered at the right hand end through suitable apertures e^1 in the end wall and into a suitable delivery trough *r* or other discharge or conveying means.

It will be seen that the chamber *a* is divided into a number of floors by floor plates *s* arranged at the levels of the top edges of respective pairs of troughs *e*. Each floor plate *s* stops short of one or other of the end walls of the chamber, so that an aperture *t* is formed at the right hand end of the bottom floor and of each alternate floor above, whilst an aperture t^1 is formed at the left hand end of the floor next above the bottom and of the alternate floors above that floor. Thus, it will be seen that if air is sucked upwards over the conveyors it will flow in counter current to the travel of the material in the conveyors, as is indicated by the arrows in Figure 1. Beneath the bottom pair of troughs there is a floor proper *u* and above the top pair of troughs there is a ceiling plate *v* formed or arranged to provide an aperture v^1 for the passage of air and gases sucked through the conveyors as hereinafter described.

The furnace or stove *c* for the supply of heated air or hot gases to the conveyors is seen in detail in Figures 5 and 6 and comprises a grate *w* with an end flue *x* leading into the space between the floor *u* and the bottom conveyor troughs and with a side flue *y* for conducting the products of combustion into an uptake *z* leading into the chimney *d*. The uptake *z* is furnished with a damper 1, the furnace end of the flue *x* is furnished with a hinged damper 2 and the exit end of the flue *x* is furnished with a damper 3. Above the furnace chamber there is formed in the setting a flue or duct 4 opening at its rear end into the flue *x* and fitted at its front end with a slide or damper 5 for controlling communication with the atmosphere. A fire door 6 controls admission to the grate and an ash pit door 7 controls access to the ash pit. When starting or when adding fresh fuel to the grate *w*, the damper 2 may be closed as seen in Figure 1 and the damper 1 may be opened, so that the smoke and products of combustion may pass up the uptake *z* direct into the chimney *d*. When the fire is clear, the damper 1 is closed and the damper 2 is opened as seen in Figure 6, so that hot gases pass from the fire through the flue *x* to the space beneath the conveyor. When use is made of coke as the fuel, it may be necessary to open the damper 1 and close the damper 2 only when starting with smoke-producing fuel. When the apparatus is in operation, the damper, 5 may be opened for the admission of any desired proportion of cold air for admixture with the hot gases. If desired, and as seen in Figure 1, two or more plugs 8 may be fitted in the side wall of the furnace *c* and, instead of opening the slide 5, one or more of the plugs 8 may be removed for giving admission of air to the flue 4. At any time that it may be required to simply cool the material in the conveyors, the damper 2 may be closed so that the fire will be damped down and only air will pass to the conveyors through the flue 4. The possibility of adjusting the opening of the ash pit door 7 also provides for another mixture of air with the hot gases from the fire, as will be readily understood. At any time, communication between the flue *x* and the treatment chamber *a* may be entirely cut off by closing the damper 3 as seen in Figure 1.

The deposition chamber *b* communicates with the space in the chamber *a* above the ceiling plate *v* by means of an opening 9 and, as seen in Figures 2 and 4, the chamber *b* contains one, two, or more vertical partitions 10 formed of wire netting or other suitable reticulated screen work. At the chimney end of the chamber *b* there is an opening 11 giving communication with the suction chamber or pipe of a powerful suction fan 12 mounted within the base chamber of the chimney shaft *d*. The opening 11 is situated at the top or in the upper part of the chamber *b* so that the current passes along the top of the chamber *b* from the opening 9 to the opening 11 and in this way any matter intercepted by the screens 10 is free to drop to the floor of the chamber *b* and well out of the influence of the current passing as aforesaid. The fan may be driven by a pulley 13 on the exterior of the chimney base and the worm con-

veyors may be driven by trains of toothed wheels driven by a primary pinion 14 on the shaft of a pulley 15 as will be readily understood by comparing Figures 2 and 3. Doors 16 and 17 may be provided for enabling the compartments of the chamber *b* to be cleared of matter deposited therein and a door 18 (see also Figure 1) may be provided for giving access to the space beneath the floor *u* which may be used as a preliminary drying chamber or storage space. There may be a damper 19 in the chimney shaft *d* controlled, through the medium of a rod 20, by a hand lever 21 situated at the foot of the chimney base. Access is had to the latter through a door 22 which is seen in the open condition in Figure 1.

In operation, the fire is started on the grate *w* as aforesaid and when the fire is clear the dampers 2, 3 and 5 are opened for the admission of the desired admixture of hot gases and air to the flue *x*. The elevator *k* and the conveyors being set in motion and also the suction fan 12 started up, the material to be treated will be delivered to the conveyors and will be propelled along the paths already indicated, whilst the suction of the fan will cause the current of mixed air and hot gases to flow counter to the travel of the material. Owing to this counter flow and to the agitation of the material by the worm blades *g* the hot gases and air will come into intimate contact with the material and will act efficiently upon the same. Then whilst the hot material is being discharged from the bottom pair of troughs through the apertures e^1 the current of cold air which is drawn in at the apertures by the operation of the fan 12, will act effectively to cool the material and enable same to be bagged from the trough *r*. By the adjustment of the various dampers as already explained, any desired temperature or degree of dryness may be obtained for the treatment current and if the material under treatment has only to be cooled or dried and cooled, the fire may be shut off and only the air admitted to the flue 4 and passing through the apertures e^1 may be passed in counter current over the travelling material. The air and gases sucked by the fan are robbed by the screens 10 of any solid material or particles entrained by them and are delivered into the chimney shaft by the fan 12. The finished material delivered into the chute *r* or other device may be bagged as aforesaid or disposed of in any other convenient manner.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In an apparatus of the kind referred to, the arrangement according to which the material is delivered from the last or bottom trough or troughs through an aperture or apertures in the outer wall of the treatment chamber or structure, substantially as and for the purpose described.

2. In apparatus of the kind referred to and embodying a furnace fitted with two damper-controlled flues, one for admission of the products of combustion directly into an uptake and the other for admission of the gases of combustion into the treatment chamber, providing the furnace also with a controlled air admission flue for admission of air to the current passing to the treatment chamber substantially as hereinbefore described.

3. In apparatus of the kind referred to, the employment of a deposition chamber fitted with screens arranged in the path of the current flowing from the conveyors to the uptake, the apertures for the entry and exit of the current into and from the chamber being disposed in the upper part of the deposition chamber substantially as and for the purpose described.

4. In apparatus of the kind referred to, the employment of worm conveyor devices each comprising a shaft mounted in a trough and formed or fitted with means for enabling a number of helical blades to be removably fixed on the said shaft in different dispositions substantially as and for the purpose described.

5. In apparatus of the kind referred to, the employment of worm conveyors each comprising a shaft having its ends revolubly mounted in bearings in box heads fitted on to the ends of the trough, the shaft being fitted with a number of helical blades or paddles designed to agitate and feed the material along the said trough substantially as hereinbefore described.

6. In apparatus of the kind referred to, the employment of a number of superposed rows of worm conveyor troughs comprising two or more such troughs in each row, the troughs being provided with end apertures suitably disposed for producing a to and fro travel of the material from a feed position at the top to a delivery position at the bottom, and horizontal partition plates being arranged between the troughs and the walls of the enclosing chamber these plates being arranged to form end apertures so disposed as to cause the treatment current to flow counter to the travel of the material, substantially as hereinbefore described.

7. Apparatus of the kind referred to for the treatment of materials with air and hot gases for the drying, cooling or like conditioning of such materials, the said apparatus comprising a furnace, conveyors, treatment chamber, deposition chamber and suction fan, all constructed, arranged and adapted for operation substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 27th day of October, 1921.

JENSEN & SON,
77, Chancery Lane, London, W.C. 2,
Chartered Patent Agents.

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[This Drawing is a reproduction of the Original on a reduced scale]

Fig. 1.

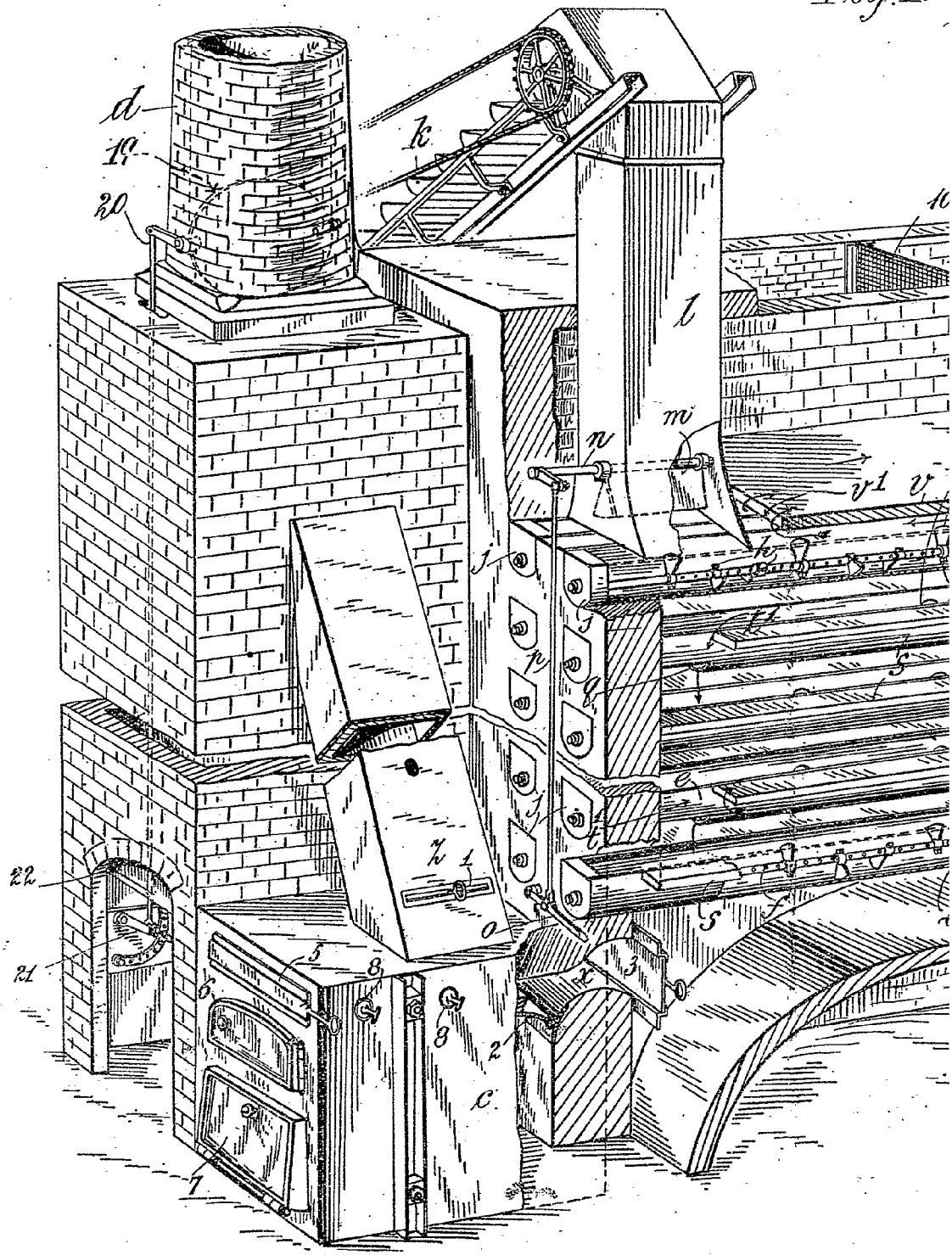

Fig. 1.

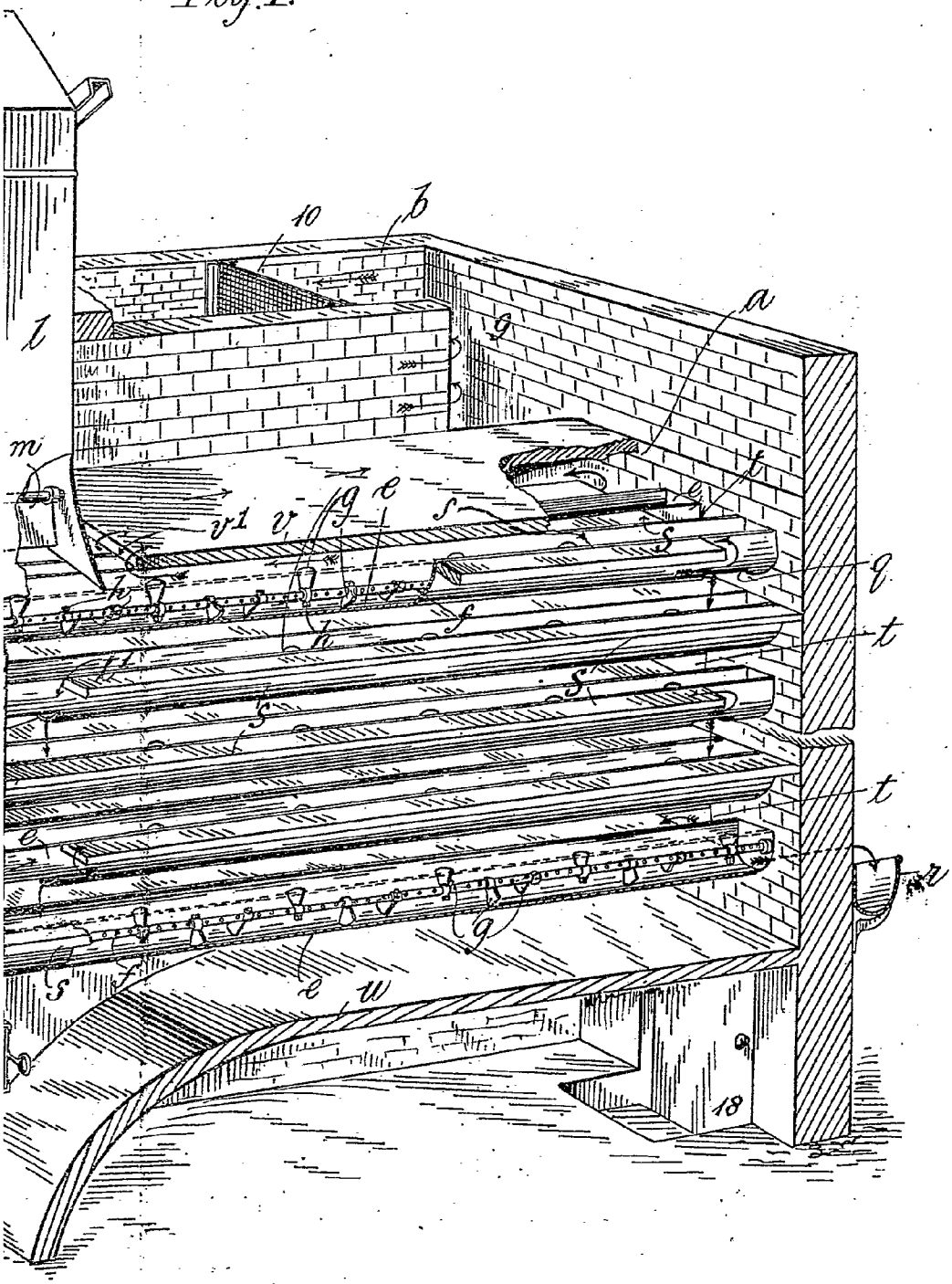

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Fig. 1.

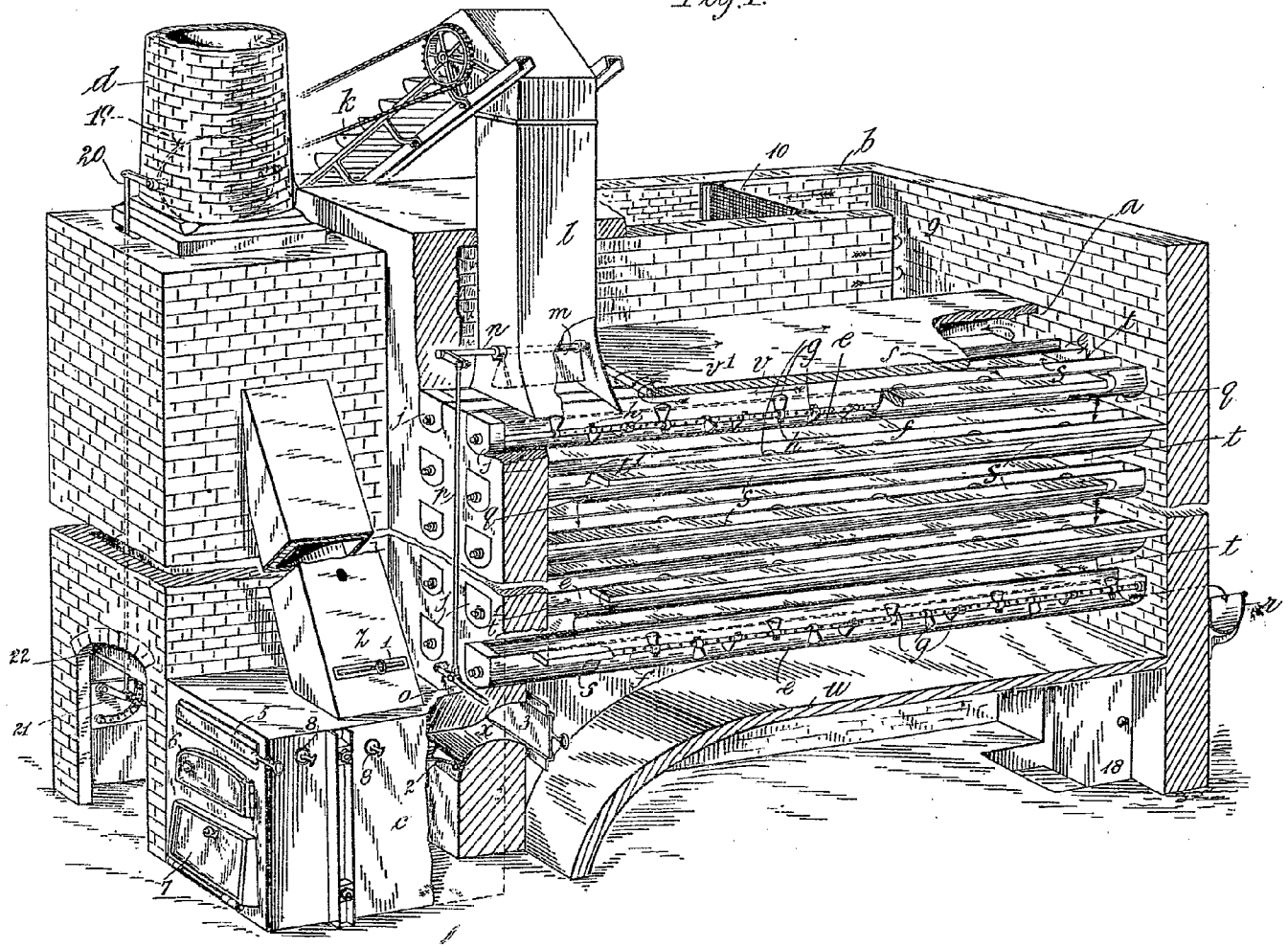

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Fig. 2.

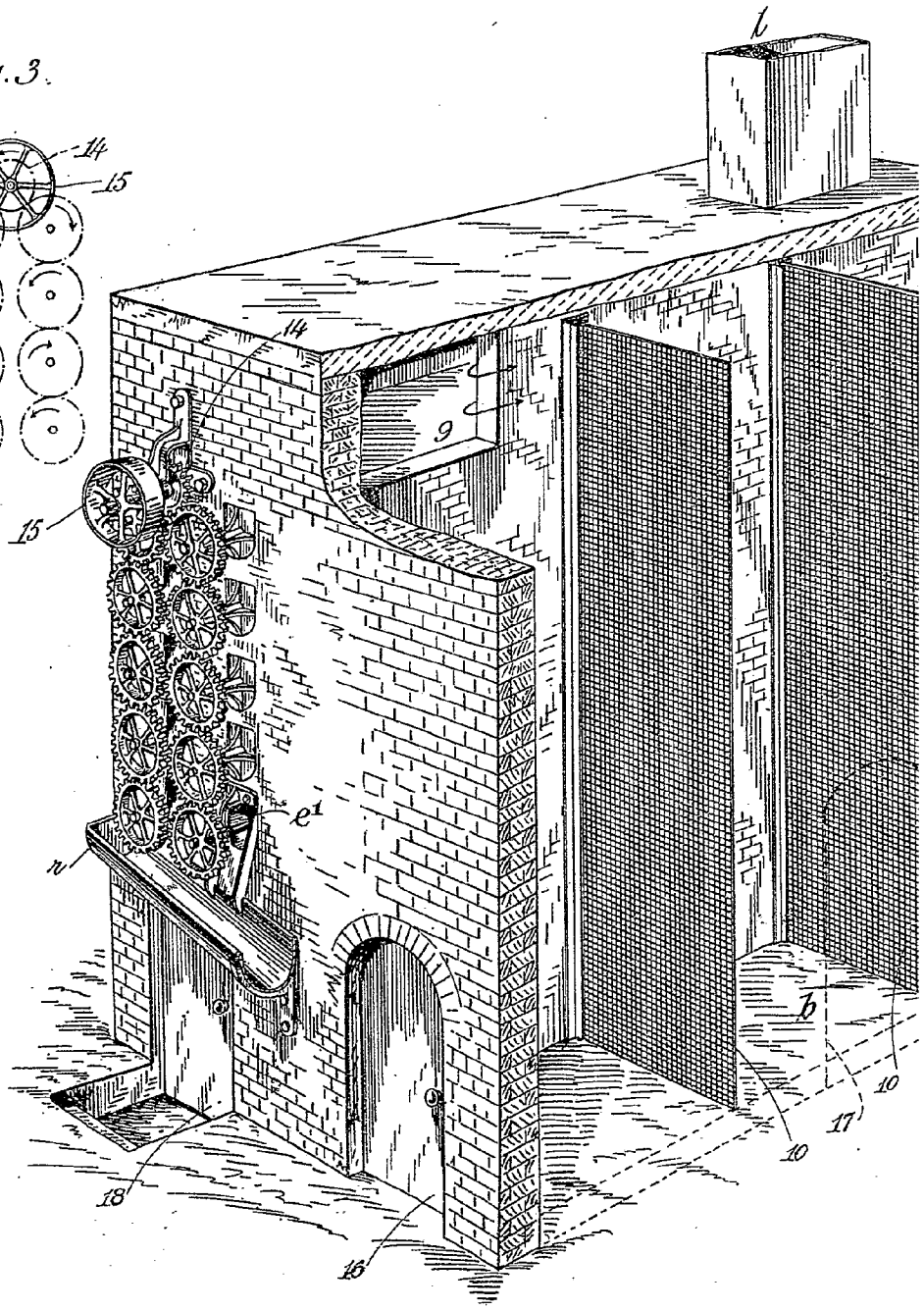

Fig. 3.

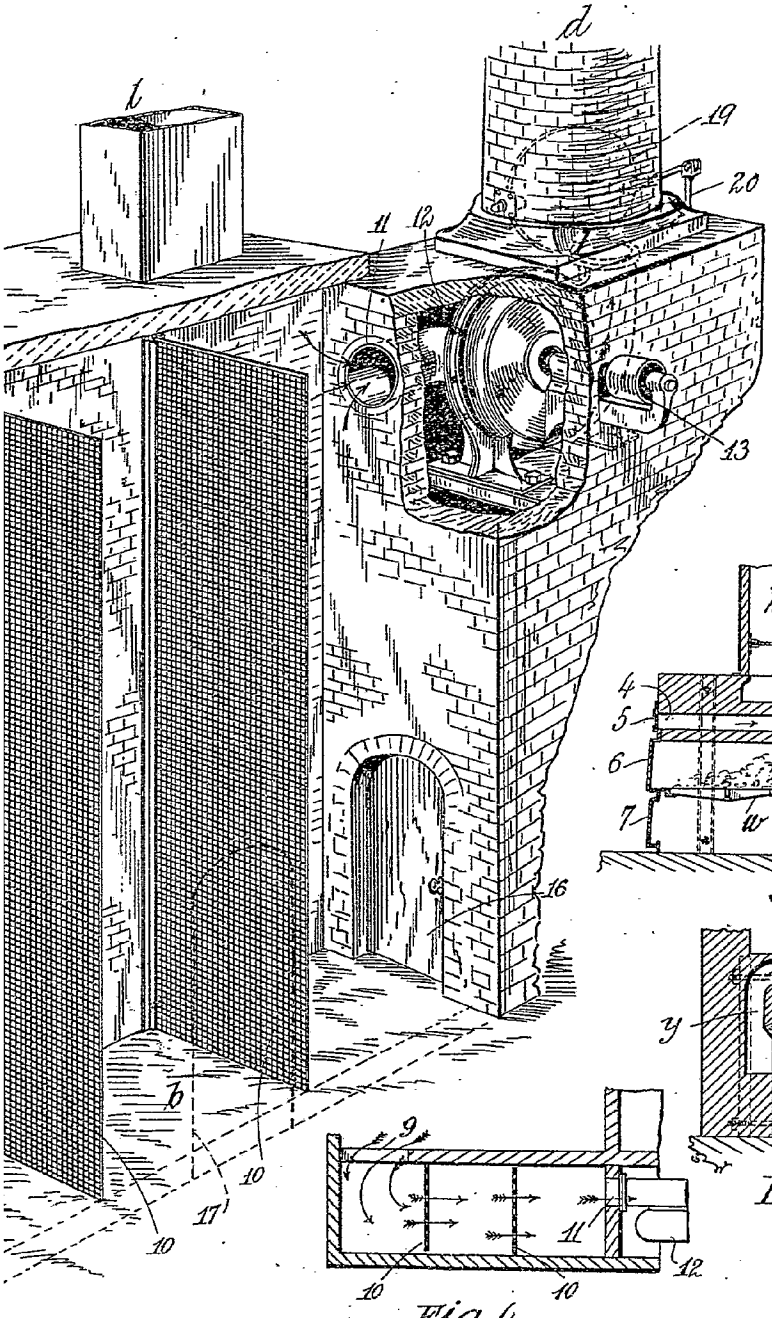

Fig. 4.

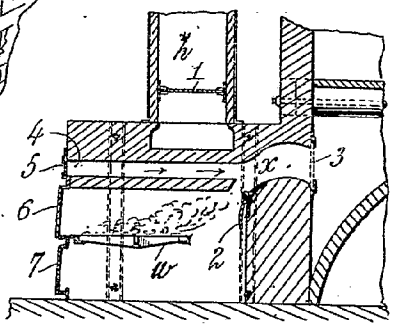

Fig. 6.

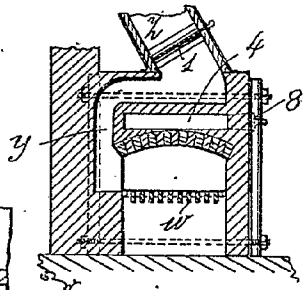

Fig. 5.

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Fig. 2.

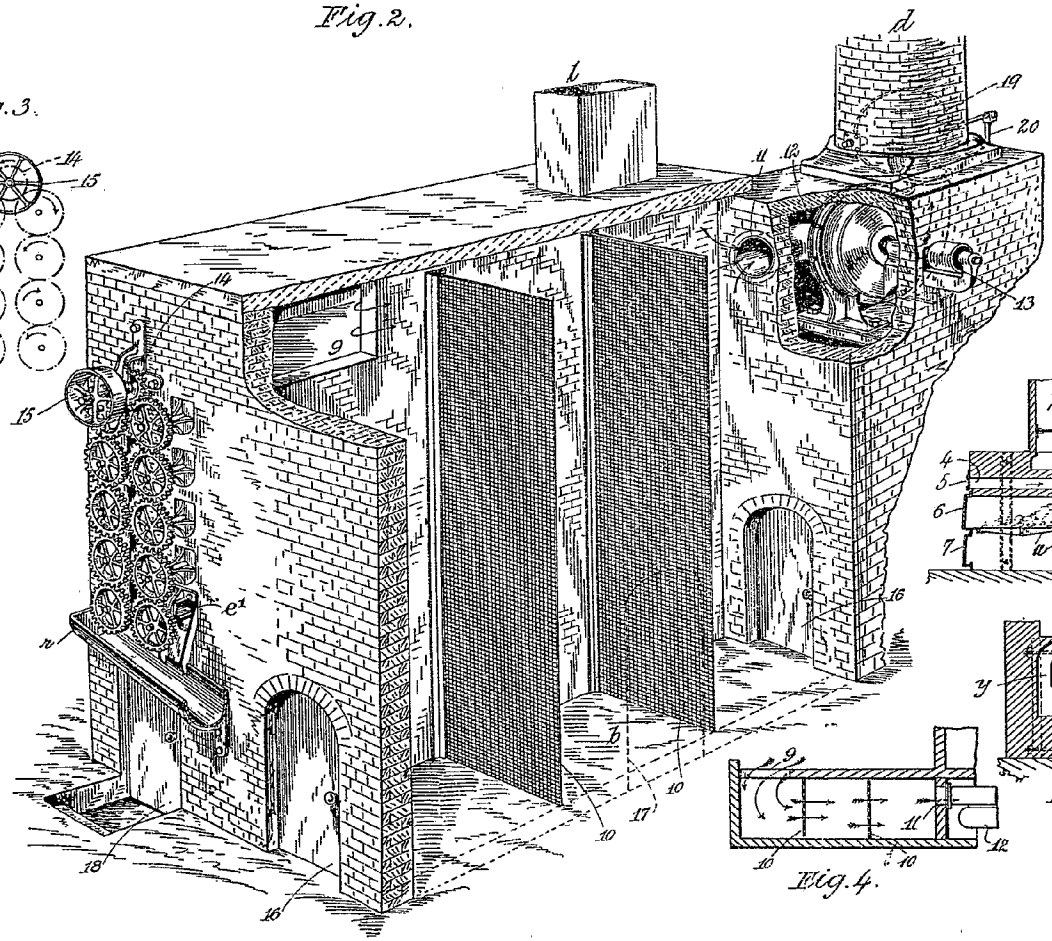
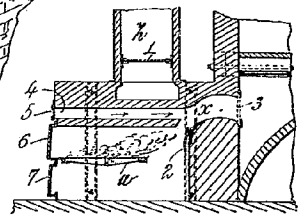


Fig. 3.

Fig. 6.



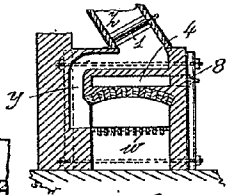


Fig. 5.

Fig. 4.

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